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INTERNATIONAL PRELIMINARY EXAMINATION REPORT (PCT Article 36 and Rule 70)



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| Applicant's or agent's file reference ABB/CRC/23/04 | FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) | |
| International application No. PCT/PL 03/00092 | International filing date (day/month/year) 18.09.2003 | Priority date (day/month/year) 26.05.2003 |
| International Patent Classification (IPC) or both national classification and IPC H01H85/046 | | |
| Applicant ABB SP. Z O. O. | | |

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| 1. | This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36. |
| 2. | <p>This REPORT consists of a total of 4 sheets, including this cover sheet.</p> <p><input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).</p> <p>These annexes consist of a total of 7 sheets.</p> |
| 3. | <p>This report contains indications relating to the following items:</p> <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the opinion II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application |

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| Date of submission of the demand 09.12.2004 | Date of completion of this report 29.04.2005 |
| Name and mailing address of the International preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 | Authorized Officer Ruppert, H Telephone No. +49 89 2399-1987  |

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/PL 03/00092

I. Basis of the report

1. With regard to the elements of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-3, 7, 8 as originally filed
3a, 4, 5, 6 received on 18.12.2004 with letter of 09.12.2004

Claims, Numbers

1-19 received on 18.12.2004 with letter of 09.12.2004

Drawings, Sheets

1/5-5/5 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. **PCT/PL 03/00092**

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

| | | |
|-------------------------------|-------------|------|
| Novelty (N) | Yes: Claims | 1-19 |
| | No: Claims | |
| Inventive step (IS) | Yes: Claims | 1-19 |
| | No: Claims | |
| Industrial applicability (IA) | Yes: Claims | 1-19 |
| | No: Claims | |

2. Citations and explanations

see separate sheet

Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following document:

D1: US-A-3 585 556 (HINGORANY ASHOK R ET AL) 15 June 1971 (1971-06-15)

Document D1, which is considered to represent the most relevant state of the art, discloses a substrate fuse according to the preamble of claim 1 from which the subject-matter of claim 1 differs in that several modules on the substrate are connected in series having at least one constriction each.

The subject-matter of claim 1 is therefore new (Article 33(2) PCT).

The problem to be solved by the present invention may be regarded as permitting the placement of a high-voltage fuse element on the flat surface of a substrate in a standard-length high-voltage fuse.

The solution to this problem proposed in claim 1 of the present application is considered as involving an inventive step (Article 33(3) PCT) for the following reasons:

No hint for this solution is found in the present state of the art.

Claims 2-19 are dependent on claim 1 and as such also meet the requirements of the PCT with respect to novelty and inventive step.

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Still another example of a electrical fuse is known from patent description US 3585 556.

5 An electrical fuse unit is shown to comprise a composite material embodying a layer of resilient metal sheet material, an electrically insulating sheet material arranged substantially coextensive with and bonded to a sheet surface of the metal sheet material, and at least one electrically conductive fuse element of selected thickness bonded to the insulating sheet material. The fuse element has a pair of terminal portions of selected width electrically interconnected by an intermediate fuse portion of relatively
10 smaller width which is fusible in response to the passage of selected electrical current through the fusible portion. The composite material has a portion formed into semicylindrical shape and has parts of the terminal portion of the fuse element disposed on opposite of the semicylindrical portion of the composite material. In this arrangement, the fuse unit is adapted to be disposed between a pair of electrical
15 contact means for resiliently engaging the fuse terminal portions with respective contact means. The invention is not limited to the production of fuses. It may be used to form heater units also. This presented design is not suitable for high voltage applications.

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The essential quality of the high-voltage thick-film high rupturing capacity substrate fuse as per the invention, comprising a tubular insulating casing closed at both ends with metal end-caps and filled with arc quenching medium, in which at least one insulating substrate is located, along whose length there is placed at least one fuse element in the form of a thin conducting film and which has terminal areas at its ends, which areas are electrically connected with the end-caps by means of specially shaped contacts located inside the end-caps, is that the fuse element consists of a basic part, formed by many identical modules having a shape resembling the letter „V” and of two end modules having a shape of one arm of the letter “V” or of a line segment, and all modules of the basic part are connecting together in series, thus forming with the end modules a sine curve having ends which are electrically connected to the terminal areas. Each module having at least one constriction allowing for the opening of the current path during fuse overload and in each module, the arms of the letter „V” of specific width are ended with arches directed outwards, which are connected with the arches of the arms of the neighbouring modules by line segments.

Preferably, the angle between the arms of the letter „V” of each module of the basic part is selected to ensure appropriate insulating gaps between neighbouring modules required for high voltage application.

Preferably, the constriction is located in the line segment connecting the arches of the neighbouring modules.

Preferably, the constriction is formed by making mirror notches in the opposite edges.

Preferably, the constriction is located on the line segment connecting the arms of the letter “V” of the module of fuse element.

Preferably, the constriction is located in the module arms and it is formed by making mirror notches in the opposite edges.

Preferably, the terminal areas are arranged perpendicular to the longer axis of the substrate.

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Preferably, fuse elements together with terminal areas are arranged on opposite surfaces of the substrate.

Preferably, inside the casing there are located at least two insulating substrates, which are separated from one another by arc quenching medium.

5 Preferably, two insulating substrates are arranged parallel to one another.

Preferably, between two insulating substrates, along the longitudinal axis of the fuse there is placed an insulating tube, in which the fuse element of the striker is placed.

10 Alternatively, the fuse incorporates three insulating substrates, arranged in such a way that, in cross-section, they form an arrangement similar to an isosceles triangle.

Preferably, between three insulating substrates, along the longitudinal axis of the fuse there is placed an insulating tube, in which the fuse element of the striker is placed.

15 Alternatively, the fuse incorporates at least two insulating substrates, arranged in a radial pattern with respect to the longitudinal axis of the fuse.

Preferably, along the longitudinal axis of the fuse incorporating at least two insulating substrates arranged in a radial pattern with respect to the longitudinal axis of the fuse, there is placed an insulating tube, in which the fuse element of the striker is placed.

20 Preferably, the insulating substrate forms a roll, which is placed longitudinally and centrally inside the casing and inside the roll formed by the insulating substrate, along the fuse longitudinal axis there is placed the insulating tube, which houses the fuse element of the striker.

25 Alternatively, the fuse incorporates at least two insulating substrates arranged so that the longitudinal axis of each insulating substrate lies on a circle whose radius intersects the longitudinal axis of the fuse, and the transverse axis of each insulating substrate deviates at an acute angle from the line connecting the longitudinal axis of the fuse with the longitudinal axis of the insulating substrate.

30 Preferably, in the longitudinal axis of the fuse incorporating at least two insulating substrates, which are arranged at an acute angle with respect to the line

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connecting the longitudinal axis of the fuse and the longitudinal axis of the insulating substrate there is placed an insulating tube in which the fuse element of the striker is placed.

- 5 Preferably, the insulating substrate is made of ceramics, glass-ceramics or glass.

The advantage of the invention is the assurance of obtaining arc voltage required in high-voltage applications, by specific shaping of an individual fuse element and by the arrangement of individual fuse elements on the substrate. The shape of an individual fuse element resembling a meander of adequate length assures that the
10 surface area of the substrate will be used to the maximum, while the outer dimensions of the substrate will be kept as small as possible. This advantage permits the placement of the high-voltage fuse element on the flat surface of the substrate in a standard-length high-voltage fuse.

The subject of the invention is illustrated by embodiment examples in the
15 drawing, where fig. 1 shows a fuse as a partial view and partial section, fig. 2 – a substrate with one fuse element and conducting areas (view), fig. 3 – an individual module of the basic part with a constriction at the vertex, fig. 4 – an individual module of the basic part with constrictions at the vertex and arms, fig. 5 – a substrate with two fuse elements and conducting areas (view), fig. 6 – a substrate with two fuse
20 elements arranged at opposite surfaces of the substrate, fig. 7 – a longitudinal section of the fuse with substrates and with the striker insulating tube and the striker, fig. 8 – a cross-section of the fuse with the striker insulating tube and with substrates arranged in a radial layout, fig. 9 – a cross-section of the fuse with the striker insulating tube and with substrates arranged in a triangle, fig. 10 – a cross-section of
25 the fuse with the striker insulating tube and with parallel arrangement of substrates, fig. 11 – a cross-section of the fuse with the striker insulating tube and with the substrate in the form of a roll placed inside the fuse casing, fig. 12 – a cross-section of the fuse with the striker insulating tube and with substrates arranged in such a way that the longitudinal axis of each substrate is situated on a circle with a radius of R ,
30 and the transverse axis of the substrate deviates at an α angle from the insulating tube radius intersecting the longitudinal axis of the substrate.

Claims

1. A high-voltage thick-film high rupturing capacity substrate fuse incorporating an insulating tubular casing (1) closed at both ends by metal end-caps (2) and filled with arc quenching medium (3), in which casing at least one insulating substrate (4) is located having at least one fuse element (5), placed on it along its length, in the form of a thin, electrically conductive film, and having terminal areas (6) located at its ends, which areas are electrically connected with the end-caps by specially formed contacts (7) located in the end-caps, characterised in that the fuse element (5) consists of a basic part, formed by many identical modules having a shape resembling the letter „V” and of two end modules having a shape of one arm of the letter “V” or of a line segment, and all modules of the basic part are connecting together in series, thus forming with the end modules a sine curve having ends which are electrically connected to the terminal areas (6), and each module having at least one constriction (9) allowing for the opening of the current path during fuse overload, and in each module, the arms of the letter „V” of specific width are ended with arches (8) directed outwards, which are connected with the arches of the arms of the neighbouring modules by line segments.
2. A fuse according to claim 1, characterised in that that the angle between the arms of the letter „V” of each module of the basic part is selected to assure appropriate insulating gaps between neighbouring modules, required for high voltage application.
3. A fuse according to claim 1, characterised in that the constriction (9) is located in the line segment connecting the arches (8) of the neighbouring modules.

4. A fuse according to claim 3, characterised in that the constriction (9) is formed by mirror notches made in the two opposite edges of the fuse element (5).
5. A fuse according to claim 1, characterised in that the constriction (9) is located in the arms of the letter "V" of the module of fuse element (5).
6. A fuse according to claim 5, characterised in that the constriction (9) is formed by mirror notches made in the two opposite edges of the fuse element (5).
7. A fuse according to claim 1, characterised in that the terminal areas (6) are arranged perpendicular to the longer axis of the substrate.
8. A fuse according to claim 1, characterised in that at least two fuse elements (5) together with the terminal areas (6) are arranged on opposite surfaces of the substrate (4).
9. A fuse according to claim 1 or 8, characterised in that inside the casing (1) there are placed at least two insulating substrates (4), which are separated from one another by arc quenching medium (3).
10. A fuse according to claim 9, characterised in that it incorporates two insulating substrates (4), which are arranged parallel to one another.
11. A fuse according to claim 10, characterised in that between the insulating substrates (4), along the fuse longitudinal axis, there is placed an insulating tube (10), which houses the fuse element of the striker (11).
12. A fuse according to claim 1 or 8, characterised in that it incorporates three insulating substrates (4), arranged in such a way that, in cross-section, they form an arrangement resembling an isosceles triangle.
13. A fuse according to claim 12, characterised in that between the insulating substrates (4), along the fuse longitudinal axis, there is placed an insulating tube (10), which houses the fuse element of the striker (11).
14. A fuse according to claim 1 or 8, characterised in that it incorporates at least two insulating substrates (4), arranged in a radial pattern with respect to the fuse longitudinal axis.
15. A fuse according to claim 14, characterised in that, along the longitudinal axis of the fuse incorporating at least two insulating substrates (4) arranged in a radial

pattern with respect to the fuse longitudinal axis, there is placed the insulating tube (10), which houses the fuse element of the striker (11).

16. A fuse according to claim 1 or 8, characterised in that the insulating substrate (4) forms a roll, which is placed longitudinally and centrally inside the casing (1) and inside the roll formed by the insulating substrate (4), along the fuse longitudinal axis there is placed the insulating tube (10), which houses the fuse element of the striker (11).
17. A fuse according to claim 1 or 8, characterised in that it incorporates at least two insulating substrates (4), which are arranged in such a way that the longitudinal axis of each insulating substrate (4) is located on the circle with a radius of (R) intersecting the fuse longitudinal axis, and the transverse axis of each insulating substrate (4) deviates from the line connecting the longitudinal axes of the fuse and the insulating substrate (4) at an acute angle (α).
18. A fuse according to claim 17, characterised in that along the fuse longitudinal axis there is placed the insulating tube (10), which houses the fuse element of the striker (11).
19. A fuse according to claim 1 or 8, characterised in that the insulating substrate is made of ceramics, glass-ceramics or glass.